# SAMPLING AND ANALYSIS PLAN

# PART 1: FIELD SAMPLING PLAN (rev. 02)

## Biotreatability Study
## Mahoning River

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**Waste Science Inc.**

**Prepared for:** Eastgate Regional Council of Governments and
US Army Corps of Engineers – Pittsburgh District

EASTGATE
Regional Council of Governments

**November 2003**

**G-221-RD-06**
**Rev. 02**

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| Name | Organization | Project Position | Version |
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*FIELD SAMPLING PLAN (REV. 02)*

*BIOTREATABILITY STUDY – MAHONING RIVER*

*NOVEMBER 2003*

## 1.0 PROJECT BACKGROUND

This Field Sampling Plan (FSP), which constitutes Part 1 of the Sampling and Analysis Plan (SAP), has been prepared for use by Waste Science Inc. (WSI) and their subcontractors in performing field sampling work associated with the Biotreatability Study of the Mahoning River. This plan describes methods, equipment, materials, and instruments to be used to collect field samples and perform field analysis, including decontamination procedures, sample handling, and waste disposal.

The Work Plan is the central project planning document that contains information specific to the project background, management organization, objectives, task performance, and schedule. The reader should refer to the Work Plan for this type of information. The FSP, which is appended to the Work Plan, is limited in scope to address only the collection and handling of sediment and water samples in the field. The Quality Assurance Project Plan, Part 2 of the Sampling and Analysis Plan, describes the laboratory analysis of those samples, quality assurance procedures, and data management and interpretation.

## 2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Project personnel and their responsibilities are described in the Quality Control Plan (QCP) and the Work Plan. The discussion includes identification of WSI personnel and subcontractors responsible for performing field sampling and safety and health functions during the field activities.

## 3.0 PROJECT TASKS

Project tasks and general procedures for performing the work are described in the Work Plan. This FSP addresses the field activities that are included under Task 5, Treatability Study. The schedule for the project also is presented in the Work Plan.

## 4.0 BACKGROUND DATA ACQUISITION

Background data reviewed in preparation for developing the sampling and analysis program for this study include a previous environmental study, "Biological and Water Quality of the Mahoning River Basin," 1996, by the Ohio Environmental Protection Agency. Other studies that are available include the USACE report "Feasibility Study On the Removal of Bank and River Bottom Sediments in the Mahoning River," 1976; and the "Environmental Dredging Reconnaissance Report." The data in these reports will be of use to select a location for the Recovering Area (moderately contaminated or acclimating) site, under the guidance of the US Army Corps of Engineers – Pittsburgh District (USACE).

Hydrologic data readily available from public websites, such as variations in flow stage, will be evaluated whenever available to assist in planning logistics for sampling and placement of inoculum. Such data may be available from the National Oceanic and Atmospheric Administration (NOAA), US Geological Survey (USGS), and USACE.

In addition, Lambda's proprietary database, and other appropriate databases, will be consulted to identify the microbes needed for development of a consortium to remediate all of the contaminants of concern and their breakdown products.

## 5.0 FIELD SAMPLING PROGRAM

The sampling program is designed to evaluate the chemical and biological quality of contaminated sediments before, during, and upon completion of the field biotreatability study. Samples will be collected at three times during the study: 1) initial sampling will establish chemical and microbial baseline information, 2) sampling will be conducted at the Test Site six weeks after inoculation, and 3) sampling will be conducted at the Test Site at the study conclusion.

During the initial sampling event, samples will be collected from three sites:

- Model Reach Site, representing baseline conditions and established cleanup goals where environmental quality of the Mahoning River meets the Ohio Environmental Protection Agency (OEPA) Warm Water Habitat (WWH) conditions;

- Recovering Area Site, where contamination is presumed to be moderate, such that existing microbes may be somewhat acclimated to the conditions and some degree of biotic recovery may have occurred; and

- Test Site, where large deposits of highly contaminated sediments have accumulated behind the low head dam in Girard, Ohio. This is the site at which the field biotreatability trial will be performed. The USACE has selected the western bank immediately upstream of the Girard dam as the Test Site.

Specific locations of the other two sites will be selected in discussions among WSI, Eastgate, and USACE, based on considerations such as anticipated contamination conditions, physical accessibility, and access rights.

The second sampling event will occur at the Test Site only, to evaluate progress of remediation, approximately six weeks after application of the microbial inoculum. The third and final sampling event will occur at the Test Site only, approximately 23 weeks after submittal of Final Work Plans. There is some flexibility in this 23-week schedule, and it could be extended if better data could be generated from a slightly longer treatment period. The decision to extend the study period will be made by WSI, Eastgate Regional Council of Governments (Eastgate), and USACE once the results from the second sampling event are available.

At each site, samples of contaminated sediments will be collected from three zones, subdividing a 50-ft length perpendicular to the river:

- River sediments, within a zone extending approximately 16 feet from the water's edge into the river. The contaminated sediments are assumed to be present at or very near the water-sediment interface in this zone.

- Ecotone sediments, within a transition zone extending from the water's edge to approximately 17 feet up the bank. The top of contaminated sediments in this transition zone is expected to be within two to three feet below ground surface, and the thickness of the sediments may be more than six feet.

- Riparian sediments, within an area approximately 17 to 34 feet from the water's edge. The sediments of interest for this study are between the ground surface and the water table, with the top of contaminated sediments expected to be present typically about three feet below ground surface.

Sample locations, sampling protocol, and field and laboratory analysis are described in the following sections.

## 5.1 Sampling Rationale and Design

### 5.1.1 Sample Locations

In advance of collection of any samples, locations of underground utilities at each site will be identified by notifying the Ohio Utility Protection Service at 800-362-2754. It is not expected that underground utilities will be present at any of the three sampling sites.

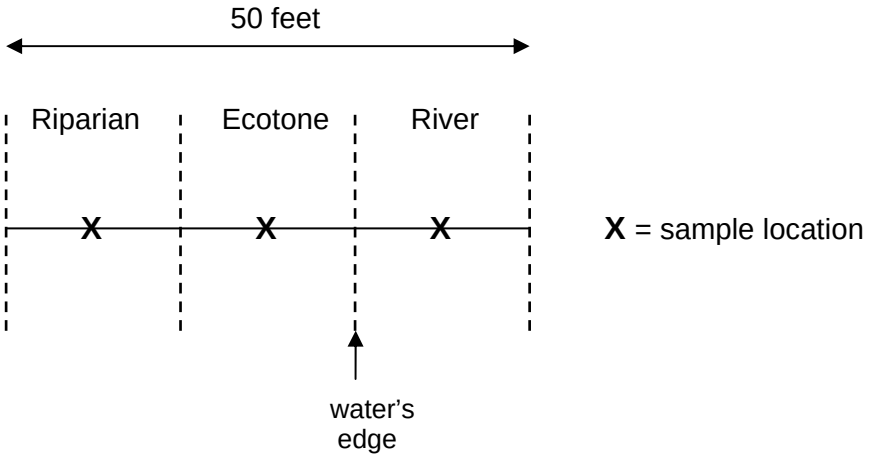
**Model Reach and Recovering Area Sites**

At the Model Reach and Recovering Area sites, a representative sediment sample will be collected from each of the three zones (river sediments, ecotone sediments, and riparian sediments) along a 50-ft length perpendicular to the river, for a total of six sediment samples. At the location of the river sediment sample at each site, a river water sample also will be collected for field analysis and limited chemical laboratory analysis. Samples will not be composited over a zone due to the limited scope of this demonstration project. However, samples at each discrete location will be

composited over a depth range, as described in Section 5.2, as a means of averaging out a range of concentrations and minimizing the likelihood of collecting a non-representative sample.

Locations will be staked in the field at the time of sampling, and will be referenced to existing site features. The samples will be collected from approximately the mid-point of each zone along the 50-ft alignment, if possible. The river sediment sample will be located approximately eight feet into the river from the river's edge, the ecotone sample will be located approximately eight feet up the bank from the river's edge, and the riparian sample will be approximately 25 feet up the bank from the river's edge. If encountered conditions dictate moving a desired sampling location (e.g., impenetrable subsurface gravel, or water too deep for the safety of sampling personnel), it will be moved to another location within the desired river/ecotone/riparian zone at the discretion of the sampling crew leader. Proposed sample locations are illustrated in Figure 5-1.

**Figure 5-1. Sample Locations - Model Reach and Recovering Area Sites**

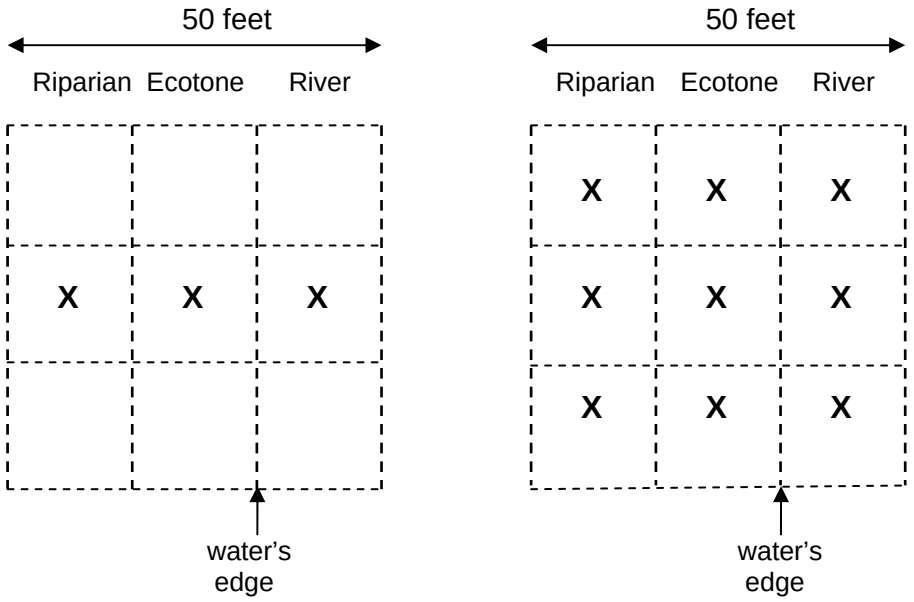



Because the Model Reach and Recovering Area sites will be sampled only once, during the initial sampling event, location reference markings will not be left on these sites.

**Test Site**

At the Test Site, a sampling plot 50 feet by 50 feet will be designated and subdivided into the three zones of interest (river sediments, ecotone sediments, and riparian (bank) sediments). Therefore approximately one-third of the sampling plot will extend into the river, as illustrated in Figure 5-2.

**Figure 5-2. Sample Locations, Test Site**




**X** = sample location

During the initial and six-week sampling events at the Test Site, samples will be collected along the center alignment, one sample in each zone, for a total of three samples during each event (Figures 5-1 and 5-2). For the final sampling event, three samples will be collected in each zone and composited, for a total of three sediment samples for this event (Figure 5-2). The greater number of sample locations during the final event will provide greater coverage of the 50-by-50-foot test plot, to assess variability in conditions after biotreatment.

A river water sample also will be collected during the initial sampling event. Field analysis and limited chemical analysis of the water sample (listed in Table 5-1) will help characterize the environmental conditions under which the microbial consortium will be cultured and then must survive and thrive after inoculation is performed.

Because the soil will be disturbed by the sampling process, subsequent samples at the same designated location will be collected within approximately one foot of the location sampled during the previous event. Locations of each sample will be measured during each sampling event with respect to sampling plot corners or other fixed reference points.

Locations will be staked in the field at the time of sampling, and will be referenced to existing site features. Because the Test Site will be sampled at three different times, reference markings (stakes and/or at-grade hubs) locating the landward corners of the 50-foot sampling plot and the

on-land sampling locations will be left in place until completion of the final sampling. Tape measurements to existing site features will also be recorded, to allow reestablishment of the sampling plot if the markers are vandalized between events.

Because the river level and therefore the location of the water's edge may vary somewhat between events, the sampling plot will be established based on the location of the water's edge during the initial sampling. If information can be obtained through readily available public sources on seasonal variation of the river level, that information will be considered when establishing the initial sampling plot.

## 5.2 Sample Depths and Collection Methods

The depth target for sampling will be the mid-depth of the contaminated layer in each zone. Contaminated sediments are described in the Statement of Work as existing under varying thicknesses of clean sediment and above the ground water (water table). Based on information from a 1998 sampling event by USACE, the top of contaminated sediments is expected to be at or near the water-riverbed interface in the river, within about two to three feet of ground surface in the ecotone zone, and at a typical depth of about three feet in the riparian zone. Therefore, sample collection will be initially targeted at the following depths below ground surface:

- Approximately zero to six inches in the river zone
- Approximately two to four feet in the ecotone zone
- Approximately four to six feet in the riparian zone.

Maximum boring depth will be 12 feet.

Sample depth targets are at the approximate mid-point of the contaminated layer, or the mid-point between top of contaminated sediments and the water table, whichever is encountered first. During the initial sampling event only, each boring in the ecotone and riparian zones will be extended to verify the bottom of the contaminated layer or depth to the water table (or refusal), whichever is encountered first, to a maximum depth of 12 feet. The depths from which samples are collected may be adjusted based on this boring information. Samples from these depth intervals will be composited to better represent the vertical distribution of contamination.

It is assumed that the contaminated sediments will be visually distinctive, based on the observed petroleum contamination. In addition, borehole vapor readings will be taken at one-foot intervals during drilling to detect petroleum vapors.

Sediment samples collected at the Test Site during the six-week and final sampling events will be from the same depths as during the initial sampling event. Sample locations along the centerline of the sampling plot will be offset approximately one foot from the sample locations in the previous sampling event(s).

River sediment samples will be collected using either a stainless steel trowel or a closed-bucket hand auger. Ecotone samples and riparian sediment samples will be collected using a power auger, if necessary, to reach sampling depth, then a hand auger at the designated sampling depth.

Samples of river water will be collected by hand-held bottles. Details of sample collection procedures are described in Section 5.5.

## 5.3 Initial Sampling Field and Laboratory Analysis

During the initial sampling, samples of river water will be analyzed in the field for the analytes in Table 5-1, and in the laboratory for salinity and fats/oils/greases only. The sediment samples will be subjected to field analysis, chemical analysis in the laboratory, and biological analysis in the laboratory, as indicated in Table 5-1.

### Table 5-1. Field and Laboratory Analysis – Initial Sampling

**Water Samples**

Field Analysis

- oxidation-reduction potential (redox)
- pH
- temperature
- dissolved oxygen (DO)
- carbon dioxide ($CO_2$)

Chemical Laboratory Analysis

- salinity
- fats/oils/greases

**Sediment Samples**

Field Analysis

- oxidation-reduction potential (redox)
- pH
- oxygen ($O_2$) availability
- hydrogen sulfide ($H_2S$)
- methane ($CH_4$)
- color (visual evaluation)
- geologic information regarding composition, texture, moisture, etc.

Chemical Laboratory Analysis

- salinity
- fats/oils/greases
- *metals, dissolved in TCLP leachate: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Fe, Mn, Ni, Zn
- total ferric iron ($Fe^{3+}$), ferrous iron ($Fe^{2+}$)
- total potassium (K)
- inorganic nitrogen as ammonia ($NH_3$)
- inorganic nitrogen as nitrite ($NO_2$)
- inorganic nitrogen as nitrate ($NO_3$)
- soluble phosphorous ($PO_4$) in deionized water leachate
- sulfate ($SO_4$)
- *total recoverable petroleum hydrocarbons (TRPH)
- *polychlorinated biphenyls (PCBs)

- *pesticides-organochlorine
- *polynuclear aromatic hydrocarbons (PAHs)
- total organic carbon (TOC)
- total organic nitrogen (TON)

Biological Laboratory Analysis

- microbe identification
- microbe viability
- microbe density

* Contaminants of concern

## 5.4 Subsequent 6-Week and Final Field and Laboratory Analyses

Based on the knowledge obtained during the initial characterization of Test Site sediments and water, a reduced analytical scheme will be used to characterize and quantify the changes in the sediment and water chemistry. Limited water analyses will be performed. In addition, the number of analytes identified and quantified in the sediments will be limited to those whose reduction will best demonstrate the effectiveness of the technology. The Interim sampling will be evaluated only to ensure that the remedy is targeting requisite contaminants and that concentrations are being reduced. This information will be used to adjust the formula and re-treat any areas that may need it. The final sampling will be used to confirm that the technology is effective in treating the contaminants and concentrations found at the Test Site.

Table 5-2 lists the subsequent analyses that will be performed.

### Table 5-2. Field and Laboratory Analysis - Interim and Final Sampling

**Water Samples**

Field Analysis (Interim event only)

- oxidation-reduction potential (redox)
- pH
- temperature
- dissolved oxygen (DO)
- carbon dioxide ($CO_2$)

Chemical Laboratory Analysis (Interim event only, none for Final event)

- salinity
- fats/oils/greases

**Sediment Samples**

Field Analysis (Interim and Final events)

- oxidation-reduction potential (redox)
- pH
- oxygen ($O_2$) availability
- hydrogen sulfide ($H_2S$)
- methane ($CH_4$)
- color (visual evaluation)
- geologic information regarding composition, texture, moisture, etc.

Chemical Laboratory Analysis (all locations for both Interim and Final events unless otherwise indicated)

- fats/oils/greases(only ecotone sample during Interim and Final events)
- *metals, dissolved in TCLP leachate: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Fe, Mn, Ni, Zn (all locations Final event only), Mn and Zn (ecotone only for Interim event)
- total ferric iron ($Fe^{3+}$), ferrous iron ($Fe^{2+}$)
- total potassium (K)
- inorganic nitrogen as ammonia ($NH_3$)
- inorganic nitrogen as nitrite ($NO_2$)
- inorganic nitrogen as nitrate ($NO_3$)
- soluble phosphorous ($PO_4$) in deionized water leachate
- sulfate ($SO_4$)
- *total recoverable petroleum hydrocarbons (TRPH) (ecotone sample only for Interim event, all locations for Final event)
- *PCB Aroclor 1260 (ecotone sample only for Interim event, all locations for Final event)
- *pesticides-organochlorine (none for Interim, all locations Final event)
- *polynuclear aromatic hydrocarbons (PAHs) (ecotone sample only for 6-Week event, all locations for Final event)
- total organic carbon (TOC) (ecotone sample only for Interim event, all locations for Final event)
- total organic nitrogen (TON) (ecotone sample only for Interim event, all locations for Final event)

Biological Laboratory Analysis (Interim event only at all locations)

- microbe viability
- microbe density

* Contaminants of concern

## 5.5 QA/QC Samples

For purposes of quality control and quality assurance, to verify the soundness of the chemical analysis results, duplicate and matrix spike/matrix spike duplicate (MS/MSD) sediment samples will be collected. The number of duplicate samples will be equivalent to no less than 10 percent of the total number of samples collected at each sampling event, which results in one duplicate sample per event. The number of MS/MSD samples will be equivalent to no less than 5 percent of the total number of samples collected at each sampling event, which results in one MS/MSD sample per event. Each MS/MSD sample and duplicate sample will be homogenized with the normal sample and split, with one MS/MSD to be analyzed by GPL Laboratories (GPL) and one duplicate and one MS/MSD to be analyzed by a USACE-specified laboratory.

The total number of samples to be collected and analyzed is shown in Table 5-3. QA/QC control samples are not proposed for the six-week sampling event, which is for progress evaluation only. In addition, QA/QC samples for the water analyses are not proposed, due to

the limited scope of this demonstration project and because the water samples are providing indicator data for culturing the microbes, not concentrations of contaminants of concern.

## 5.6 Field Procedures

### 5.6.1 Sampling Methods for Water and Sediments

**Sampling Methods for River Water**

Water and underwater sediment samples within the river will be collected by wading to the designated sampling location, in water no deeper than two feet. The sampling technician will wear a personal flotation device, in accordance with the Safety and Health Plan (SAHP), as well as hip or chest waders.

**Table 5-3. Samples and QA/QC Requirements**

| Type of Sample | Measurements | Quantity | Quality Control Requirements |
|---|---|---|---|
| 1) Test Site river and bank sediments<br>2) Recovering Area river and bank sediments<br>3) Model Reach river and bank sediments | Contaminants of Concern; biological indicator samples; quality indicators as shown in the FSP | Nine samples (one in each of three sampling zones at each of three sites) | One set of 10% of samples as duplicates (= one sample for USACE-specified lab), and two sets of 5% of samples for matrix spike/matrix spike duplicate (= one sample for GPL, one sample for USACE-specified lab) |
| Six-Week efficacy testing sampling | Contaminants of Concern; biological indicator samples; quality indicators as shown in the FSP | Three samples (one in each of three sampling zones at Test Site) | None |
| Project conclusion efficacy sampling | Contaminants of Concern; biological indicator samples; quality indicators as shown in the FSP | Nine samples (three in each of three sampling zones at Test Site) | One set of 10% of samples as duplicates (= one sample for USACE-specified lab), and two sets of 5% of samples for matrix spike/matrix spike duplicate (= one sample for GPL, one sample for USACE-specified lab) |

Grab samples of river water will each be collected at the same location as the associated river sediment sample, prior to collection of the sediment sample. The water sample will be collected approximately six inches above the water/sediment interface, taking care to minimize disruption of bottom sediments. A clean wide mouth jar will be filled by positioning the mouth of the jar upstream, and moving it slowly upstream. During the final sampling event, when three samples

are collected in the river, the samples will be collected in a sequence moving from downstream to upstream, to prevent cross-contamination of downstream samples by upstream activities.

The water sample for field analysis will be left with head space for gas analysis, but the bottle for laboratory analysis will be filled to the top. After wiping the rim of the bottle, the lid will be screwed on tightly and the exterior of the bottle will be rinsed with distilled water. The sample container for laboratory analysis will be wiped dry and labeled using a label provided (see Appendix A of QCP). Sample number, date, time, location, depth of water, depth of sample, type of analysis, and sample collector's name will be recorded on the sample label. As soon as they are labeled, sample containers will be placed in a cooler with ice to preserve the sample at approximately 4oC. Data for the sample will be recorded in the field log book.

## Sampling Methods for Underwater Sediments

Sediment samples within the river will be collected by wading to the designated sampling location, in water no deeper than two feet. The sampling technician will wear a personal flotation device, in accordance with the Safety and Health Plan (SAHP), as well as hip or chest waders.

Care will be taken to avoid disturbance of sediments at the sampling location, i.e., the sampling technician will stand on the downstream side of the sampling location. As described for the water sampling, during the final sampling event, when three samples will be collected from the river, the samples will be collected in a sequence moving from downstream to upstream, to prevent cross-contamination of downstream samples by upstream activities.

The underwater sediment samples will be collected using a stainless steel trowel or a closed-bucket, stainless steel hand auger. The sample will be placed in bottles without mixing, to minimize loss of gases.

When placing each sample in each bottle, any standing liquid will be poured off the top of the bottle and more sediment will be added until the bottle is full, except in the sample for field analysis which will be left with head space for gas analysis. After wiping the rim of the bottle, the lid will be screwed on tightly and the exterior of the bottle will be rinsed with distilled water. The sample container will be wiped dry and labeled using a label provided (see Appendix A of QCP). Sample number, date, time, location, depth of water, depth of sample, type of analysis, and sample collector's name will be recorded on the sample label. The container will be placed in the cooler with ice to preserve the sample at approximately 4oC, and the data will be recorded in the field log book.

## Sampling Methods for Sediments on Land

The sediment samples on land will be collected using a closed-bucket, stainless steel hand auger. If necessary, a power auger will be used to drill to the sampling depth. Loose material will be removed from the hole and a temporary PVC casing will be inserted to prevent cave-in during sampling, if necessary. The sample will then be collected with the stainless steel auger from the desired depth. Sample material for volatiles analysis (the field sample and the laboratory TRPH sample) will be moved as quickly and directly as possible, without mixing, from the sampler to the sample container, to minimize loss of volatiles. These non-composited

samples for volatiles analysis will be selected from approximately the mid-point of the depth range being sampled, unless that depth appears unrepresentative of the depth range.

Material for non-volatile analyses, obtained from throughout the depth interval sampled, will be placed on plastic, mixed gently to homogenize, and distributed among the remaining containers to provide representative samples integrated over the depth interval sampled.

When filling each bottle, any standing liquid will be poured off the top of bottle and more sediment will be added until the bottle is full, except in the sample for field analysis which will be left with head space for gas analysis. After wiping the rim of the bottle, the lid will be screwed on tightly and the exterior of the bottle will be rinsed with distilled water. The sample container will be wiped dry and labeled using a label provided (see Appendix A of QCP). Sample number, date, time, location, depth of sample, type of analysis, and sample collector's name will be recorded on the sample label. As with the river samples, the containers will be placed in a cooler with ice to preserve the samples at approximately 4oC, and sampling data will be recorded in the field log book.

## 5.7 Field Measurement Procedures

Field measurements will be made for those parameters that are time or temperature sensitive, where transportation to the laboratory for analysis would result in non-representative readings. In addition, volatile organic compounds will be screened in the field, for two purposes: 1) to monitor levels of contamination and help identify optimal sampling depths, and 2) to monitor the breathing zone as required in the SAHP.

During drilling for initial sampling, organic vapor measurements will be taken by holding the probe of a photoionization detector (PID) in the opening of the boring after approximately every foot of penetration, to provide a qualitative indication of the presence of contaminated sediments. If a gasoline-powered auger is used, the auger will be turned off and the hole covered with plastic. The air will be allowed to stabilize for at least one minute before a reading in the hole is obtained. (PID readings for safety and health monitoring will be taken in the breathing zone, not downhole.) All measurements will be recorded on the boring log and on the Air Monitoring data sheet (SAHP, Appendix A).

Field measurements of each sample will be performed immediately following collection. A separate bottle will be filled for field analysis; because the measurements will be made immediately, labeling of the field analysis sample bottle is unnecessary. Samples used for field measurements will be managed as investigation-derived waste.

For each river water sample, measurements will be performed using a multimeter to measure dissolved oxygen ($O_2$), carbon dioxide ($CO_2$), oxidation-reduction potential (redox), pH, and temperature, according to Table 5-1. In addition, a PID will be used to take a gross measurement of total volatile organic compounds. The measurements of gases ($O_2$, $CO_2$, PID) will be performed first, followed by measurement of the other parameters. Sample data will be recorded on the Log of Daily Activities provided in Appendix A of the QCP. Information will include sample number, date, time, location, depth of water, depth of sample, river flow description, PID readings, relative turbidity, each measured parameter and results, and the sample collector's name. Upon completion of the measurements, the water sample will be disposed as described in Section 8.0.

For each sediment sample, measurements will be performed using a multimeter to measure available $O_2$, $CO_2$, hydrogen sulfide ($H_2S$), methane (CH4), oxidation-reduction potential, pH, and temperature, according to Table 5-1. The measurements of gases will be performed first, followed by measurement of the other parameters. Sample data will be recorded on the Log of Daily Activity provided in Appendix A of the QCP. Information will include sample number, date, time, location, depth, water depth for underwater sediment samples, PID readings, color, each measured parameter and results, and the sample collector's name. Upon completion of the field measurements, the sediment sample will be disposed as described in Section 8.0.

## 5.8 Field Quality Control Sampling Procedures

Field duplicates of sediment samples will be prepared for the chemical laboratory by homogenizing sample material from a given location and dividing it equally between the normal sample and duplicate bottles. Matrix spike/ matrix spike duplicate (MS/MSD) samples for the chemical laboratory will be prepared similarly, by homogenizing sample material from a given location and dividing it equally between the normal sample and MS/MSD bottles. One set of duplicates will be prepared, for shipment to a USACE-specified laboratory. Two sets of each MS/MSD sample will be prepared, for shipment to GPL and to a USACE-specified laboratory.

## 5.9 Sample Containers and Preservation Techniques

Sample containers, required preservation techniques, maximum holding times, and analytical methods are shown in Table 5-4. The two laboratories will provide certified clean bottles with the appropriate preservatives. All samples will be stored and shipped in coolers to maintain their temperature at approximately 4$^{o}$C, except those being transported to the biological laboratory. Those samples will be kept at ambient temperatures.

**Table 5-4. Sample Containers, Preservation, Holding Times, Analytical Methods for Soils**

| Analytes | Containers | Preservation | Holding Times | Analytical Methods |
|---|---|---|---|---|
| Salinity - Water | 250ml glass jar | Cool to 4$^{o}$C | 28 days | 2520B |
| Fats/oils/greases - Water | 1L amber glass jar | HCl or H2SO4 to pH<2, cool to 4$^{o}$C | 28 days | E413.1 |
| Salinity - Soils | 8oz widemouth glass jar | Cool to 4$^{o}$C | 28days | 2520B |
| Fats/oils/greases - Soils | 8oz widemouth glass jar | Cool to 4$^{o}$C | 14 days | SW9071 |
| Metals in TCLP leachate: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Fe, Mn, Ni, Zn | 8oz widemouth glass jar | Cool to 4$^{o}$C | 14 days to leach | (SW1311) SW6010B/SW7471 |
| Total Ferric Iron (Fe3+), Ferrous Iron (Fe2+) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 6 months | SW6010B + STD METHOD 4500 |
| Total Potassium (K) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 6 months | SW6010B |
| Inorganic Ammonia ($NH_3$) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 28days | E353.2 |
| Inorganic Nitrite -Nitrogen ($NO_{2-}$) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 48hrs | E354.1 |

| Analytes | Containers | Preservation | Holding Times | Analytical Methods |
|---|---|---|---|---|
| Inorganic Nitrate - Nitrogen ($NO_{3-}$) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 48hrs | E350.3 |
| Soluble Phosphorous ($PO_4$) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 28 days | E365.2 |
| Sulfate ($SO_4$) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 28 days | E375.4 |
| Total Range Petroleum Hydrocarbons (TRPH) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 28 days | E418.1 |
| Polychlorinated Biphenyls (PCBs) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 14 days | SW8082 |
| Pesticides-organochlorine | 8oz widemouth glass jar | Cool to 4$^{o}$C | 14 days | SW8081A |
| Polynuclear Aromatic Hydrocarbons (PAHs) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 14 days | SW8270 |
| Total Organic Carbon (TOC) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 28 days | SW9060 |
| Total Organic Nitrogen (TON) | 8oz widemouth glass jar | Cool to 4$^{o}$C | 28 days | TKN- E351.4 NH3-E350.3 |

### 5.10 Decontamination Procedures

Decontamination activities will take place on plastic sheeting. Sampling equipment will be decontaminated in disposable tubs placed on the plastic sheeting.

The sampling and measuring equipment (stainless steel hand auger, bowl, spoon, water sampling bottle, tape measures, multimeter probe, etc.) will be decontaminated before the first sample and between sampling locations as follows:

1. Scrub the exterior and interior of any sampling equipment with non-phosphate detergent and clean brush, as needed.
2. Rinse equipment with distilled water.
3. Air dry or dry with paper towels.
4. Place on clean plastic sheeting.

Decontamination water and other waste materials will be disposed as described in Section 8.0, describing the management of investigation-derived waste.

## 6.0 FIELD OPERATIONS DOCUMENTATION

### 6.1 Daily Field Reports

Daily activities will be recorded in the field logbook and reported by telephone daily to the WSI project manager, who will provide daily updates to Eastgate, as required in the Statement of

Work. For each day of field work, a summary of activities will be recorded on a Log of Daily Activities (see Appendix A of QCP), a copy of which will be attached to the final study report.

## 6.2 Field Logbook and Sample Data Forms

Information pertinent to the sampling effort will be recorded in a bound logbook as the activity occurs. The field logbook will contain any administrative occurrences, conditions, or activities that may affect the field work or data quality of any environmental samples or field QC samples on any given day or during a given field task. The front of the logbook will list the project name, the contract number, the names of project contacts, and the dates of the field activities. Each page will be consecutively numbered, dated, and signed. All entries will be made in indelible ink, and all corrections will consist of single line-out deletions that are initialed and dated. If only part of a page is used, the remainder of the page will have an "X" drawn across it. Entries in the logbook will include, but not be limited to, the following:

1. Dates and times of all entries.
2. Descriptions of all site activities, including site entry and exit times.
3. Site sketch.
4. Weather conditions.
5. Unique, sequential field sample numbers.
6. Location, description, and depth of each sampling point.
7. Name of the field contact.
8. Identification of sampling crew members and any personnel on site.
9. Type of sample (e.g., sediment).
10. Number of bottles and volume of sample taken.
11. Requested analyses.
12. Sampling methodology, including distinction between grab and composite samples.
13. Sample preservation.
14. Date and time (military) of sample collection.
15. Field observations (e.g., oily sheen on water sample, incidental odors).
16. All field measurements (e.g., pH, depth to water, photoionization detector [PID] readings).
17. Signature and date of the personnel responsible for observations.

Because sampling situations vary widely, no general rules can specify the extent of information that must be entered in a logbook. However, records will contain sufficient information so that someone can reconstruct the sampling activity without relying on the sampler's memory.

## 6.3 Sample Numbering System

A unique identifying sample number will be assigned to each sediment sample. The first letter will identify the site (M for Model Reach, R for Recovering Area site, T for Test Site), the next

letter will represent the zone of the sampling plot (R for River, E for Ecotone, P for Riparian), the next letter will represent the alignment within the plot (M for mid-line in the first two events; then N for north alignment, M for middle alignment, and S for south alignment in the final sampling event), and then two digits will represent the month of sampling. For example, sample number TEM08 represents:

| | |
|---|---|
| T | Test Site |
| E | ecotone zone of sampling plot |
| M | middle sample of three total collected within ecotone zone |
| 08 | August 2003 |

The grab samples of river water will be identified by a "W" prefix (e.g., WTRM08). Duplicate samples will be identified by appending a "D" to the sample number. Samples for MS/MSD samples will be identified by appending "MSMSD" to the sample number.

## 6.4 Sample Labels

Each sediment and QC sample will have a sample label uniquely identifying the sampling point, sampling time, and analysis parameters. As each sample is collected, a sample label with the following information will be applied to the container:

1. Project name.
2. Project number.
3. Site and location identification – Model, Recovering, or Test site; and River, Ecotone, or Riparian zone.
4. Field sample number.
5. Date of sample collection.
6. Time of sample collection.
7. Analysis to be performed.
8. Preservatives, if any.
9. The number of containers (i.e., 1 of 2, 2 of 2).
10. Initials of collector.

The label information will be double-checked by the sampling technician to ensure that it is correct. The completed label will be affixed to the sample container, and will be covered with clear tape, completely encircling the container.

## 6.5 Chain-of-Custody Records

A chain-of-custody form will be used to track the custody of the samples from the collection point to the analytical laboratory. The chain-of-custody form (see Appendix A in QCP) will include the following information:

1. Site name, project name, and project number.
2. Field sample number.

3. Date of sample collection (for each individual sample).
4. Time of sample collection (for each individual sample, in military time).
5. Total number of containers per sample.
6. The analyses requested for each sample container, including size and type of container.
7. The type of preservative, if any, in each container.
8. Name of analytical laboratory.
9. Name and signature of sampling team leader.
10. Date and time samples were relinquished, signature of person who relinquished samples, and, if possible, signature of person accepting samples.

Two copies of each chain-of-custody form will be prepared. Both copies will be signed and dated by the sampler. One (the "original") will be placed in a zip-lock bag and taped to the inside lid of the sample cooler, and one will be retained by the sampler. The original chain-of-custody form will be signed by laboratory personnel and returned to WSI for inclusion in the final report.

## 6.6 Field Equipment Calibration

As described in the QAPP, Section 4.3, calibration of field instruments will be performed at the beginning of the work and on a daily basis if the sampling event takes longer than one day. The instruments will be calibrated according to manufacturers' instructions, and the data will be recorded in the field log book.

## 6.7 Sampling Forms and Boring Logs

Water sampling data and sediment sampling data will be recorded on a Log of Daily Activities for each sampling location within the river zone.

For each sample collected in the ecotone or riparian zones, data will be recorded on a Boring Log, also provided in Appendix A of the QCP. Recorded data will include the method of advancing the borehole (e.g., hand auger, power auger, casing installed and removed), descriptions of the soils encountered throughout the depth of the borehole (including identification of the contaminated sediments), depth to the water table if encountered, identification and depth of the sample collected, PID readings taken approximately every foot throughout the depth of the borehole, and field measurements taken on the sample.

Copies of the Log of Daily Activities and the Boring Logs will be provided in the final study report.

# 7.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Proper sample packing is essential for the safe delivery of unbroken sample containers that will provide reliable environmental data. Samples going to the GPL and Lambda laboratories will be hand-delivered. Shipping procedures apply to those samples being shipped to the USACE-specified laboratory. Prior to shipment or hand-delivery, the following procedures will be performed on each sample container:

1. The cap tightness will be checked and it will be verified that clear tape covers the label and completely encircles the container.
2. Each sample container will be wrapped in bubble wrap or closed cell foam sheets (shipped samples only).
3. Each sample container will be enclosed in a clear zip-lock plastic bag.

Once the above procedures have been completed for each sample container, the following procedures will be performed for each sample cooler:

1. Several layers of bubble wrap will be placed on the bottom of the cooler. The cooler will be lined with an open garbage bag, all samples will be placed upright inside the garbage bag, and the bag will be tied.
2. Appropriate sample documentation (i.e., chain-of-custody forms) will be placed in a waterproof plastic bag (zip-lock bag), and the bag will be taped to the underside of the cooler lid. If more than one cooler is being used, each cooler will have its own documentation.
3. Each cooler will be sealed with signed and dated custody seals so that if the cooler were opened, the custody seal would be broken. Clear tape will be placed over the custody seal to prevent damage to the seal.
4. Each cooler will be taped shut, and tape will be placed over the cooler drain (if the cooler has a drain plug).

Coolers will be delivered by personal vehicle to the laboratories listed below:

| | |
|---|---|
| Biological laboratory name: | Lambda Bioremediation Systems, Inc. |
| Address: | 2824 Fisher Rd., Columbus, OH 43204 |
| Phone: | 614-278-2600 |
| | |
| Chemical laboratory name: | GPL Laboratories, LLLP |
| Address: | 202 Perry Parkway, Gaithersburg, MD 20877 |
| Phone: | 301-926-6802 |
| Fax: | 301-840-1209 |

The QA samples for the USACE-specified laboratory will be either delivered to Eastgate offices or shipped to the laboratory by overnight delivery, as per request by the client.

# 8.0 INVESTIGATION-DERIVED WASTES (IDW)

This section describes the management of the investigation-derived wastes (IDW) generated during the field sampling activities. Investigation-derived waste can include soil cuttings, disposable PPE, waste papers and plastic, decontamination water, and other trash.

## 8.1 Soil Cuttings

Soil cuttings derived from sampling activities in the on-land locations are not expected to be hazardous, and will be placed back into the borehole location from which they were removed. No excess cuttings are expected to be produced from sampling activities.

## 8.2 Decontamination Water

Commercial distilled water will be used for decontamination water. The water will be used to wash and rinse sampling equipment in plastic buckets. Based on data from the 1996 water quality report, concentrations of contaminants are expected to be low. Because the quantity of wash water generated at each site will be small and the concentrations of contaminants are expected to be low, the water will be discharged onto the ground beyond the limits of the sampling plot, upon completion of each sampling event.

## 8.3 Disposable Supplies

All used plastic sheeting, gloves, and other disposable supplies associated with sampling and equipment decontamination will be bagged and disposed as non-hazardous solid waste in an appropriate trash receptacle.

# 9.0 REFERENCES

Ohio Environmental Protection Agency (OEPA), 1996. *Biological and Water Quality Study of the Mahoning River Basin*. May 1996.

US Army Corps of Engineers (USACE), 2001. *Engineering and Design - Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3.* February 2001.

## 10.0 PLAN APPROVAL AND SIGNOFF

This Field Sampling Plan (FSP) has been written for the exclusive use of WSI, its employees, and subcontractors. The plan is written for the specified site conditions, dates, and personnel. It must be amended if these conditions change. Subcontractors may need to supplement this plan, as needed, to address specific tasks they will be performing. This plan is valid only when all signatures appear below.

**PLAN APPROVAL:**

Approval by: _____ Date: _____
Eastgate Project Manager

Concurrence by: _____ Date: _____
WSI Project Manager

Concurrence by: _____ Date: _____
USACE Project Manager